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Research Article

Development of a Smart Attendance System Using Face Recognition Technology

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Abstract: Attendance management is an essential component in educational institutions, companies, and organizations to monitor the presence and punctuality of participants. Traditional attendance systems, such as manual signatures or identification cards, are prone to various issues including human error, time inefficiency, and identity fraud. To address these challenges, this study aims to develop a smart attendance system using facial recognition technology based on Python and the OpenCV library. The system is designed to automatically detect and recognize faces in real time using a webcam or camera module. It employs computer vision techniques to capture facial images, extract unique features, and match them against a stored database of registered participants. Once the face is verified, the system records the attendance along with a timestamp, ensuring data accuracy and security. The development process involved several stages, including image acquisition, preprocessing, feature extraction, and classification. OpenCV was utilized for image processing tasks, while Python provided the programming framework to integrate all components. To enhance recognition accuracy, the system applied techniques such as histogram equalization for lighting normalization and Haar Cascade classifiers for initial face detection. An experimental evaluation was conducted under various conditions, including different lighting environments and facial orientations. The results demonstrated that the system achieved an accuracy rate of 96% under normal lighting conditions, with only a small decrease in performance under dim or uneven lighting. These findings indicate that the system is reliable for practical applications, especially in controlled environments. Conclusion: The Python-based facial recognition attendance system offers a more efficient, secure, and accurate alternative to conventional attendance methods. Future improvements may include the integration of deep learning models to enhance recognition robustness in diverse real-world scenarios.

Keywords: Attendance, Computer, Face, OpenCV, Vision

1. Introduction

Every human being needs to get an education and learn life skills, which are found in the world of education (Faridahtul Jannah & Thooriq Irtifa' Fathuddi, 2023). According to (Wardana et al., 2019), education is a process in which students mature and develop their abilities, potential, and life skills. Therefore, education needs to be designed to share effective understanding and be able to improve student learning outcomes. Education plays an important role in producing humans who are smart, creative, and adaptive to changing times. Along with the development of globalization and technological advances, the world of education is faced with demands to produce students who are not only able to understand the subject matter, but also have creative thinking skills. Creative thinking is the ability to generate new ideas, come up with solutions from various perspectives, and create unique and original ideas (Widana & Septiari, 2021). This is in line with the view of (Wulandari et al., 2019) that having creative thinking skills is important because it facilitates students' ability to adjust their thinking, consider various points of view, and generate various solutions. According to (Permatasari, 2023) Creativity is one of the main elements in 21st century learning, as stated in Permendikbudristek No. 16 of 2022 which emphasizes the importance of creating a learning atmosphere that provides space for student initiative, creativity and independence. Based on

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these conditions, this study focused on the implementation of creative thinking skills of fifth grade students at SDN Kebonsari Kulon 1 Probolinggo. This research emphasizes the four main aspects of creative thinking, namely fluency, flexibility, originality, and elaboration, which are important indicators in fostering students' creative thinking skills. This finding is in line with the argument (Anwar et al., 2012) which states that creative thinking involves a new approach, which includes four main aspects, namely fluency, flexibility, originality, and elaboration.

Previous research has discussed the application of 21st century skills-based learning. One of them is research by Bening Arum Amalia (2022) entitled "Implementation of Creative, Critical Thinking, Communicative, Collaborative (4C) Skills in Islamic Religious Education Learning at SMKN 1 Purwokerto". The analysis used a descriptive qualitative approach with active learning and cooperative learning methods. The results show that the application of 4C-based learning strategies is effective in improving students' thinking skills. However, the focus of the research is still general and has not explored one aspect in particular, such as creative thinking skills. In addition, the object of research is at the secondary education level and in certain subjects, so it does not represent the conditions and needs of elementary school students as a whole. The advantage of this study is a more specific focus on creative thinking skills at the elementary school level with a context that is closer to daily learning practices.

The problem of concern in this study is the uneven ability to think creatively among fifth grade students. This is evident from the initial observation which shows that some students are able to solve tasks or problems with a creative approach, while other students still show difficulty in finding the right solution. Thus, although learning strategies that support creativity have been implemented, the impact has not been maximized on all students. Therefore, this analysis seeks to explore more thoroughly the implementation of creative thinking skills in class V by examining the four main indicators of creative thinking. This analysis uses a descriptive qualitative approach that intends to provide a factual and in-depth description of the implementation of creative learning in an elementary school environment.

The solution offered through this analysis is to conduct an in-depth analysis of the application of each creative thinking indicator in the learning activities of grade V students. It is hoped that the results of this study can be a material for reflection as well as a reference for teachers in developing more adaptive and creative teaching strategies. This approach is not only beneficial for teachers and students, but also relevant for curriculum development and educational policies that support the improvement of learning quality in elementary schools.

This research is expected to contribute in several aspects. First, for teachers, this research can be a source of information and reference in creating teaching strategies that are interesting and suitable for student characters. Second, the results of this study are expected to improve students' creative thinking skills, making them stronger and ready to overcome future difficulties. Third, for researchers, this research is a place to increase awareness and understanding of the importance of innovation in education. Finally, for other researchers,

this research can be the basis for a broader follow-up study on 21st century skills, especially creative thinking skills at the basic education level.

2. Preliminaries or Related Work or Literature Review

In research (Sulastri et al., 2022) with the title Implementation of Problem Based Learning Model to Improve Creative Thinking Skills of Elementary School Students in Science Learning. The findings revealed that students in two schools showed significant improvement in creative thinking by meeting superior standards in all aspects. In contrast, the other school showed moderate improvement in originality and high scores in fluency, flexibility and elaboration. This study thus confirms that the problem-based learning model is successful in improving creative thinking skills among primary school students in science education.

In research (Amalia, 2022) with the title Implementation of Creative, Critical Thingking, Communicative, Collaborative (4C) Skills in Islamic Religious Education Learning at SMK Negeri 1 Purwokerto. The results of this study found that the implementation of skills (4C) in Islamic Religious Education learning at SMK Negeri 1 Purwokerto has been implemented using active learning models and also cooperative learning with discussion and presentation methods.

In research (Kharismawati Putri et al., 2022), with the title Improving Creative Thinking Ability of Elementary Students Using Problem Based Learning Model Assisted by Video Media. This study indicated a significant increase in students' creative thinking skills after conducting problem-based learning with video media, with the average level of completeness increasing from 43% to 57% in cycle I and reaching 84% in cycle II.

From various previous research reviews, there is no research that examines in depth the implementation of creative thinking skills. This implementation explains the implementation of creative thinking skills in grade V students at SDN Kebonsari Kulon 1 Probolinggo from the beginning of planning to evaluation in the learning process in the classroom. Previous research explored the application of learning models and approaches, as well as the influence of creative thinking in learning. To differentiate this study, the researcher provides a detailed description of the implementation process, including planning, implementation, and evaluation.

3. Proposed Method

This research applied a qualitative descriptive approach to explore and describe the creative thinking skills of fifth grade students at SDN Kebonsari Kulon 1 Probolinggo. According to (Hairani et al., 2019) descriptive qualitative research aims to provide a detailed description of the phenomena that occur at the location. The research subjects consisted of 23 fifth grade students. Information collection strategies were carried out through interviews, observation, and documentation (Sugiyono, 2020) Interviews were conducted with two respondents, namely school leaders and grade V teachers. Observation was carried out for 3

days during learning in class V. Documentation taken in the form of photos and supporting documents. The instrument used is an assessment rubric that focuses on four aspects of creative thinking, with several indicators to measure students' creative thinking skills during learning activities. Data analysis was carried out by reducing data, presenting data, and drawing conclusions. Data reduction aims to summarize relevant information, while data presentation aims to complement existing findings. Research conclusions can change if new findings are found in the field that can affect the results of the analysis.

4. Results and Discussion

This section presents the research results obtained from the process of observation and analysis of the creative thinking skills of fifth grade students at SDN Kebonsari Kulon 1 Probolinggo. This research was conducted to find out how students develop their creative thinking skills in classroom learning activities. The data presented are the results of information collection through observation, interviews, and documentation during learning activities. The assessment of students' creative thinking skills refers to four main aspects, namely fluency in expressing ideas (fluency), the ability to generate a variety of ideas (flexibility), uniqueness or originality of ideas (originality), and the ability to develop ideas in detail (elaboration). In its implementation, the teacher uses various learning models such as Problem Based Learning (PBL), Give a Question and Get an Answer, combined with group learning activities. The results of this assessment are then summarized in the form of a table that displays student scores on each indicator of creative thinking skills.

Table 1 Recapitulation of 4 aspects of creative thinking skills

No	Aspek	Aspek	1	2	3	4
1.	*Fluency* (Kefasihan)	a. Siswa sering mengajukan pertanyaan			✓	
		b. Siswa dapat memberikan banyak ide				✓
		c. Siswa mampu mengungkapkan gagasan dengan lancar				✓
2	*Flexibility* (Keluwesan)	a. Siswa mampu memberikan ide yang kreatif				✓
		b. Siswa dapat menjelaskan cerita atau masalah lebih banyak				✓
		c. Siswa mampu mengelompokkan informasi atau ide berdasarkan kriteria yang berbeda			✓	
3	*Originality* (Keaslian)	a. Siswa mampu menghasilkan ide baru				✓
		b. Siswa mampu mempertanyakan cara lama dan dapat memberikan cara baru				✓
		c. Siswa mampu menyelesaikan tugas dengan penyelesaian yang baru				✓
4	*Elaboration* (Keterincian)	a. Siswa mampu menjelaskan dengan rinci				✓
		b. Siswa mampu menjelaskan secara runtut				✓

Description:

4 : Excellent : Demonstrates a deep understanding of the problem and shows very creative thinking skills

3: Good : Demonstrate a good understanding of the problem, and demonstrate creative thinking skills

2: Good enough: Shows sufficient understanding of the problem, but still needs guidance to improve creative thinking skills.

1: Poor : Shows a lack understanding of the problem and showed a lack of creative thinking ability.

Based on research on grade V students at SDN Kebonsari Kulon 1 Probolinggo, it can be concluded that teachers have implemented learning that is aligned with the teaching module and consider learning models and methods that can encourage students to think creatively. The fifth grade teacher used varied approaches such as Problem Based Learning (PBL) and Giving Question and Giving Answer (GQGA) models combined in cooperative learning. These approaches are proven to be effective in activating students and supporting the development of their creative thinking skills.

The fluency aspect refers to an individual's ability to generate diverse and varied ideas when solving problems (Hafiza et al., 2022). The indicator of the fluency aspect is asking many questions. In the implementation, it can be seen that grade V students are active in presentation activities where each group that becomes the audience asks questions related to the topic learned today but there are also some students who still do not feel brave enough to ask questions. Students' ability to formulate questions was also seen when the teacher assigned tasks to students by making various questions by drawing free flat shapes based on area and perimeter. Then the second indicator has many ideas about a problem, clearly seen when students conduct group discussions where students try to find relevant information related to the problems given then develop their various opinions in the group so that students get various perspectives of each group. The last indicator is being able to express ideas fluently, this can be seen during the presentation, each child expresses their ideas using their own language fluently, then this is also seen when students answer questions correctly and clearly. It is known that when working on problems students look for the appropriate formula then work by copying the numbers contained in the problem and concluding the final result.

Flexibility refers to the ability to adjust strategies or methods to achieve a solution. The flexibility aspect in students according to (Qomariyah & Subekti, 2021) is that when faced with a problem, students can think creatively and produce various solutions. Flexibility aspect has three indicators of creative thinking. The first indicator is the ability to provide creative ideas for an object. This can be seen during learning, the teacher distributes lighter questions in order to stimulate students' creative thinking skills. Students answered the teacher's

questions creatively without any restrictions. The same thing was also seen during the division of tasks, where the teacher asked students to make questions by drawing and giving the area and size of the flat space drawing, with that students were able to make various questions according to students' own thoughts. Then the second indicator is to provide more explanation of a picture, story or problem. This implementation was seen during the observation, each student analyzed the problems given and then discussed with their group members to dig up more information related to the problem and combine all the information that group members got to answer the problem in more detail. this was also seen when students worked on problems by explaining the steps of work in more detail. The third indicator is the ability to classify ideas based on varied criteria, it is clearly seen that when grouping there are only a few students who are able to do this indicator for other students. The way students who have been able to classify ideas based on different criteria is by analyzing the problems given by the teacher then discussing with their group members and then categorizing the problems into different categories. This can also be seen when students work on assignments by matching flat building formulas based on the question.

The original aspect is the skill of learners in developing different or uncommon ideas that show their creative thinking (Candra et al., 2019). The originality aspect has 3 indicators, namely generating unique ideas, analyzing old approaches and developing new strategies and being able to complete tasks with new solutions. These indicators are very relevant to group learning methods, especially discussions, because during discussions it is seen that students try to solve their problems which are trained to see different opinions so that from this collection of ideas from their group members they can find unique ideas. Unique ideas can be analyzed again to find new solutions that are more relevant and effective to overcome existing problems. So that with this procedure they can solve the problem in a new, more appropriate way.

The Elaboration aspect according to (Yuliani, 2017) is to develop existing ideas and describe the solution process thoroughly and structured. Elaboration aspects with indicators of students being able to explain with a logical sequence and in-depth explanation. this can be seen when students present because in the presentation each group will present the results of their discussion to their classmates with their own understanding. Students use language that is easy to understand so that the explanation conveyed can be arranged coherently, in detail and interrelated so that the explanation given can be conveyed appropriately. In addition, students are also able to complete the task by identifying the knowledge they already have and the questions that need to be answered by the task and then answer according to the formula and then solve the problem in detail. then students are also able to explain coherently starting by mentioning the appropriate formula for calculating the area of a flat shape, then mentioning what is known by the problem, and replacing the known values by the formula and calculating the results and giving the final answer.

5. Conclusions

Based on the research results, the creative thinking skills of fifth grade students at SDN Kebonsari Kulon 1 Probolinggo are classified as very good overall. However, there are two aspects that need more attention, namely shyness to ask questions in the fluency aspect and difficulty in grouping ideas in the flexibility aspect. Nevertheless, the application of creative thinking skills has been very effective, as seen from the excellent results in the aspects of originality and elaboration, where students are able to generate unique ideas and explain ideas in detail.

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